

According to further aspects of the invention, the manager of a SAN as described above notifies the operator/administrator of SAN events such as, by way of non-limiting example, failure or disconnection of a storage device from the SAN. The manager permits specification (e.g., by the administrator) of a delay interval (or "alert interval") between a first and subsequent notifications of an event. Upon receipt of an event notification from an agent, for example, the manager can implement this mechanism by determining, e.g., from a database or otherwise, whether a previous notification of was made to the administrator. If so, further notification is made only if the current time follows that of the previous notification by the specified alert interval.

In further aspects, the invention provides a SAN as described above in which the manager maintains policies for handling events pertaining to (i) attributes of at least selected hosts and/or (ii) establishment of relationships of at least selected hosts with one or more storage units. A policy engine included within the manager responds to notification of at least a selected event by effecting execution of an action according to the policy maintained therefor.

In a related aspect, the policy engine includes a module, herein referred to as an automation module, that receives events from the agents and associates each event with a policy applicable to that event to form an [event, policy] pair. For example, as discussed in more detail below, when an agent file system monitor detects that the utilized portion of a file system associated with a managed host has exceeded a pre-defined threshold, it transmits an event notification to the policy engine. The policy engine determines, based on a pre-defined policy, whether the file system of this managed host should be extended. If the pre-defined policy calls for the extension

of the file system, the policy engine identifies which LUN should be utilized and requests that a LUN manager assign the identified LUN to that host.

Further aspects of the invention provide systems as described above in which the manager
5 maintains in a relational database a topological or other representation of the storage area
network, or aspect thereof. In response, for example, to notification from an agent of addition of
a component to the SAN, the manager instantiates an object oriented programming (OOP) object
reflecting attributes of the component. This object, referred to below as a "manager" object can
also include, for example, method members for collecting those attributes (e.g., from other
10 databases or stores in the manager, or elsewhere). The manager instantiates one or more further
objects, referred to as "peer" objects, that store persistable data from a corresponding manager
object. These peer object are mapped into the relational database and, thereby, facilitate transfer
of the persistable data to and from it.

15 *Event Processing*

The invention provides in other aspects improvements on a digital data processing apparatus of
the type that manages a SAN and maintains an internal representation thereof, e.g. of the
topology of the SAN. The improvements include providing a first queue with entries
20 representing tasks and a second queue with entries representing data for processing in connection
with those tasks, where the data in the second queue is grouped in accord with the task to which
it corresponds. A manager service updates the internal representation of the SAN (e.g., the

representation of the SAN topology) by executing the tasks in the first queue one at a time, for example, atomically using a single-threaded process.

Further aspects of the invention provide improved apparatus as described above in which the
5 data contained in the second queue constitute event notifications, e.g., generated by a detection
service in response to changes in the SAN. That service can receive, for example, from agents
associated with host digital data processors on the SAN, information regarding the hosts and
storage devices to which they are connected via an interconnect. In related aspects of the
invention, the detection service discerns changes in the SAN and generates notifications by
10 comparing information or "scans" from the agents with previously stored scans. One or more
notifications can be generated corresponding to each change and transmitted to the manager for
placement on the queues. The notifications can reflect, for example, that a new host or storage
device has been added to the SAN, that the attributes of such a device have been modified, that a
device is missing, and/or that a relationship between a storage device and host has changed.

Further aspects of the invention provide improved apparatus as described above in which the
15 manger service selectively adds notifications received from the detection service to the second
queue until receipt of a selected notification, e.g., indicating that the underlying scan is complete.
The service manger can, upon such receipt, generate for addition to the second queue an object-
20 oriented programming (OOP) object, or other construct, execution of which effects processing of
the prior notifications for the same underlying change detected by the service manager.